Patent Application of

Dennis J. Gregerson

For

TITLE: Rotary broom attachment for traction vehicles

CROSS-REFERENCE TO RELATED APPLICATIONS

FEDERALLY SPONSORED RESEARCH Not applicable

BACKGROUND OF THE INVENTION—FIELD OF INVENTION

This invention relates to rotary angle broom sweeping attachments for skid steer loaders.

BACKGROUND OF THE INVENTION

The concept of employing rotary brooms to sweep flat surfaces has been around for some time. Configurations for rotary brushes are either transverse, where the brush axis of rotation is parallel to the ground, or vertical, where the brush axis of rotation is perpendicular to the ground. There are also single brush configurations and multiple brush configurations. The present invention deals with both a transverse single brush that will be referred to as simply "the brush" and a single vertical brush that will be referred

to as a "gutter broom". It would be clear to one skilled in the art that this invention could be applied to other brush orientations and multiple brush assemblies as well.

Numerous improvements to rotary brushes have been made: Mechanisms have been developed to change the angle of the broom relative to the direction to in which it is being moved or drawn as related in U.S. Pat. No. 1806054; Differing methods were developed to drive the brush as presented in U.S. Pat. No.s 2229229 and 3284831; Ways were devised to raise and lower the brush as in U.S. Pat. 524709; Contrivances were created to keep the brush parallel with the surface being swept U.S. Pat. No. 6446297. There are also numerous ways in which the broom can be moved across the swept surface such as self-powered brooms where the broom assembly has its own means to drive the brush. Rotary brooms have been pulled or pushed by any prime mover including animal power since their inception as seen in U.S. Pat. No. (30644). Rotary brooms have been adapted to fit onto many diverse types of motor vehicles not specifically created with sweeping in mind. These vehicles include road graders, trucks, lawn mowers, utility tractors as well as skidsteer loaders.

Skidsteer loaders, because of their extreme maneuverability and quick response are very well adapted for Rotary broom skidsteer attachments. These broom-equipped skidsteers are employed in the landscape industry to sweep leaves and level compost. They are used in agriculture for a number of tasks such as cleaning livestock pens and aiding in removing grain or granular fertilizers from large flat storage bins. Parking ramp attendants use them to sweep dirt and snow.

The motion of an object such as a brush assembly can be one of six types. There are threedirections of linear motion and three types of rotational motion. Linear motion is non-rotational motion of an object along one of the three Cartesian coordinate axis, i.e. forwards/backwards, side to side, or up/down. Rotational motion is the spinning of an object about any one of the three Cartesian axis. For the purposes of this invention, the following terms will be used. The three linear degrees of motion are described in common language terms such as forward/backward, up and down, and side to side. These linear directions will

also be used to define axis of rotation for rotational motion. Rotation about the forward/backward axis will be called roll, rotation about the up/down axis will be called yaw, and rotation about the side-to-side axis will be called pitch.

The skidsteer loader is an excellent means by which to power a rotary broom, but the design of all previous rotary broom attachments heretofore known suffer from a number of disadvantages that inhibit their effectiveness:

(a) The operator's view of the sweeping operation is impaired in the manner by which that conventional rotary brooms attach to the skidsteer. Most attachments are connected to the skidsteer by what has become known as the "quick attach adapter". The invention discussed in U.S. Pat No. 3672521 has become an industry standard for quickly mounting tools such as buckets or pallet forks to the skidsteer. The quick attach adapter and its mounting position is illustrated in Bobcat brochure number B-1619 and Sweepster brochures numbers LH 6/00 and BDA 3/02. As is evident in these brochures, skipped spots that the operator he has missed will not be apparent to him until he has traveled far enough forward to allow him to catch sight of them out his rear window. This can be a significant distance depending on the design of the skidsteer loader. To address a skipped spot, will require the operator to move the skidsteer to the spot, reposition the brush at the point where he started to skip, and re-sweep the area. The
operator will again not know if he has fully accomplished his task until he can again view the area in question out of his rear window.

(b) An operator of a conventional skidsteer powered angle broom attachment has a limited vision to the sides of the skidsteer. Operating a skidsteer with a rotary broom attachment other than in an unobstructed open area requires the operator to have good visibility of objects that are in close proximity of the machine.

The extremely quick response and maneuverability of the skidsteer operating in a close proximity to stationary objects as walls, raised sidewalks, or parked vehicles exemplify the operator's need to have the best visibility possible. Sweeping when pedestrians are present makes this need even more crucial. The main boom arms of skidsteers must be in a specific position for all sweeper attachments to function. Refer to Bobcat brochure number B-1619 and Sweepster brochures number LH 6/00 and BDA 3/02. These brochures illustrate the position at which the boom arms must be maintained to effectively power conventional rotary brooms. The boom arms run diagonally, starting low at the front of the skidsteer and increase in height to a point at the rear of the skidsteer. An increasingly large blind spot is formed beginning at the sides of the skidsteer and culminating at the rear of the machine. Jackson's invention, U.S. Pat No. 6446297is a rotary broom attachment for a non-conventional type of skidsteer that has the operator's platform on the rear of the skidsteer. The operator of this type of skidsteer has a different field of vision from that of an operator of a conventional skidsteer loader. If this device where modified for use on a conventional skidsteer the operator's view of the sweeping operation would be improved. However the position of the "Quick attach adapter" would critically interfere with the operator's view
of objects in his forward direction of travel. This is due to the "The controlling surface illustrated in drawing Fig. No. 6 and the mounting surface number 13" of U.S. Pat. No. 6446279 must be in a relatively vertically position for the device to function. Additionally, for this device to be adapted to conventional skidsteers the distance between the skidsteer and the brush would have to be increased along with all its controlling members. A device of this proportion would mean that the brush would be at a considerable distance ahead of the skidsteer making the sweeping attachment front end heavy, cumbersome and hard to control.

(c) It is apparent that adjustable angle rotary broom skidsteer attachments heretofor known are limited in the amount of tilt (yaw) to about thirty degrees. As illustrated in "Bobcat brochure number B-1619", "Sweepster brochures numbers LH 6/00 and BDA 3/02" and "BRADCO brochure B-AM 2/02". The reason for this limitation is that when the broom is angled more than thirty degrees the brush will not cover both right and left wheel tracks of the skidsteer that powers it. Drawing Fig.s 1a, 1b, and 1c illustrate a conventional angle broom attachment with the brush in three positions of tilt (yaw). In Fig. 1a, the brush is in the transverse or straight position. In Fig. 1b, the brush is tilted thirty degrees. In Fig. 1c, the brush is tilted thirty-five degrees. Comparing Fig.s 1b and 1c illustrates how the additional five degrees of yaw will fail to cover the wheel track of the skidsteer. This failure to cover the wheel track will increase the occurrence of cross contamination of the area that has been swept. Fig. 1c also demonstrates that the wheels of the skidsteer will come in contact with a vertical object running parallel with the skidsteer before the brush will. This inhibits the broom's ability to sweep close to vertical objects without leaving a skip when the broom is angled.

The inability of angle broom attachments to operate with an angle (yaw) greater than thirty degrees has additional drawbacks:

(1) Additional power is required to drive the brush because more of the material being swept comes to rest in the path of the brush rather than to the side. This means that the brush has to continually re-sweep a greater portion of the sweepings with each pass until it is cleared to the side of the skidsteer. In referring to Drawing Fig.s 2a and 2b which are drawings of the same sweeper attachment. The brush in fig. 2a is angled less than the brush in fig. 2b. Number 10 of fig.s, 2a and 2b, indicate a box shaped area depicting where the swept material will

come to rest as the brush continues on a forward path. Number 20 of fig.s, 2a and 2b, is a box shaped area representing the sweepers forward path. Number 30 of fig.s, 2a and 2b, indicates the triangular shaped areas that represent the swept particles that will initially clear the sweepers path as it moves forward. Number 40 of fig.s, 2a and 2b, indicates a four sided polygonal area that represents particles that have been swept at least once and will be swept again as they have came to rest in the broom's path. The area represented by number 40 of figure 2b is significantly smaller than the area represented by number 40 of figure 2a. The difference in the size of these two areas will represent the continuous additional amount of re-swept material that the less angled brush will encounter in its forward sweeping path. It is apparent that less power will be needed by the brush that is angled more because less re-swept material will be encountered with each pass of the broom.

(2) The continued re-handling of the sweepings, as has been substantiated, will increase the wear on the bristles and substantially reduces the service life of the brush in general.

(d) Prior art does not address the use of skidsteer-powered brushes to clean surfaces such as walls and ceilings. Previous skidsteer powered rotary angle brooms have been designed to sweep on a relatively flat plane that extends parallel with the ground. A need has been identified for a device which will aid in cleaning the walls and ceilings of such things as semi-truck trailers, barges, storage bins, and bunkers.

(e) Prior art was reviewed for an effective and economical way for skidsteer loaders that are quipped with only one auxiliary hydraulic circuit to operate

both the drive motor and the angle adjustment from the operators seat. A need has been recognized for this and is addressed in U.S. Pat. No. 6354081. As is discussed in this patent, skidsteer loaders are equipped with only one auxiliary hydraulic circuit with one valve controlling the oil flow. Rotary angle brooms need two such circuits to be efficient (One circuit to supply oil flow for the motor that powers the brush and one circuit to supply oil to the cylinder that adjusts the angle (yaw) of the broom.) The search of prior art revealed that except for this device the only other way found to accomplish this task was to add an additional hydraulic valve, either manually or electrically operated. These valves are typically mounted on the broom. Prior to my invention the operator could not reach the manually activated valve from his seat, requiring him to stop the machine and leave the operator's compartment to manipulate the valve. An electrically operated solenoid valve would allow the operator to operate the valve from his seat. However an array of burdensome electrical wires and connectors would be needed to make it function. The skidsteer must also be wired with a means to control the valve. Additionally an electrical connection must be made each time the broom is attached to the skidsteer and diconnected each time the broom is detached. The electrical solenoid valve, wires, connections, and, controls are prone to operational difficulties. This system often fails, which is not surprising when one considers the environment the skidsteer is designed to operate in. The device, U.S. Pat. No. 6,354,081 appears to have solved the problem of controlling two separate rotary broom functions with one auxiliary hydraulic circuit supplied by the skidsteer. The cost involved in using this option to accomplish the task is greater than what is needed as well as being much more complicated.

(f) Prior to my invention it was impossible for skidsteer powered rotary angle brooms, operated in an angled position, not to leave skips next to vertical structures. Refer to drawing figures 10b and 10c. The right side wheels of the

skidsteer will contact a continuous vertical surface before the brush can get close. Many commercial street sweeper manufacturers add what is called a gutter broom to their sweepers to overcome this problem (refer to Broce Broom brochure titled "Optional Curb Sweeper".) Currently makers of skidsteer sweeper attachments have added them to "bucket brooms" as referenced to in a YORK brochure titled, "Model SSPU York Skid Steer Loader Mounted Sweeper". A bucket broom can be described as a sweeper attachment for skidsteer loaders that have a rotary brush fixed to the front of a bucket tool attachment. The rotary brush deposits the sweepings into the bucket, in essence acting like a large dustpan. Hydraulically driven gutter brooms have been attached to these bucket brooms to allow the device to sweep next to vertical structures. These hydraulically driven gutter brooms can easily be added to rotary angle broom skidsteer attachments but there is no prior art giving evidence of this fact. If a manufacture were to add a conventional hydraulically driven gutter broom to a rotary angle broom skidsteer attachment there would be a number of problems to overcome:

(1) The gutter broom mount and the rotary broom structure must be sturdy enough to support the high torque generated by the gutter broom drive and endure continual incidental contact that is indigenous to the gutter brooms normal operation;

(2) The gutter broom must be fixed to the rotary angle broom in such a way as to be folded out of the way to a position that would not interfere with the operation of the rotary brush when not immediately needed;

(3) Typically, many sweepers that employ gutter brooms are hydraulically driven. To install a gutter broom on a rotary angle broom skidsteer attachment would require adding an additional hydraulic system. This

would entail installing an elaborate hydraulic system to power the motor that drives the gutter broom, additional to the system discussed in paragraph (e) under Background of the Invention-Prior Art;

(4) The gutter broom must be fixed to the rotary angle broom in such a way as to be removed easily if the need arises;

(5) A speed control would have to be devised to keep the gutter broom rotating at a rate proportional to the rate of rotation of that of the rotary brush;

(6) The hydraulically driven gutter broom would have to be configured to the rotary angle broom in such a way that the gutter broom could be operatively angled (yaw) in conjunction with the rotary brush;

(7) An overall design would have to be employed that would give the operator the ability to control the pitch angle of the gutter broom while automatically maintaining alignment with the rotary brush;

(8) An overall design that would provide the operator an unobstructed view of the gutter broom in operation as well as objects that the gutter broom may encounter. This design would also need to allow for the operator to assess the quality of the sweeping operation and make needed adjustments ongoing;

(9) Devise a way to elevate the gutterbroom, when the attachment is not in operation to protect it from being damaged.

(g) All brushes used by rotary angle brooms of the type under discussion, must be elevated off the ground when not in use. This precaution protects the brush and also prevents the brush from getting flat spots. All manufacturers of skidsteer-powered rotary angle broom attachments provide a means by which to elevate the brush. It is either crank down jacks or adjustable legs that must be lowered. Usually at least one of either the jacks or legs are needed for each right and left side of the sweeping attachment. Please refer to prior art Bobcat brochure number B-1619, Sweepster brochures numbers LH 6/00 and U.S. Pat. No. 6035478 (reference number 94 "lift jack cranks"). Conversely when the broom is being prepared for use these jacks or legs must be raised. A task although necessary is quite time consuming and can be easily overlooked if the skidsteer operator must switch attachment tools frequently during the day;

(h) In reviewing prior art as U.S. Pat. Nos. 6035478 and 6,354,081 representative drawings of typical rotary angle broom attachments it becomes apparent that inspecting and maintaining the brush and its drive components is hampered by their design in general. The brush cover limits access to these items when the rotary angle broom is detached from the skidsteer and resting on the support legs or jacks. Unless the skid steer is employed to raise the broom to where the brush and its drive can be reached more easily, access is to these areas is unduly difficult;

(i) Rotary angle brooms of current production have either a formed sheet metal cover or one made of thin molded plastic. Refer to typical prior art parts illustrations as in "BRADCO parts illustration CI-40" and "Bobcat parts illustration volume 3 attachments figure 61" item number 1). Both types are held in place with numerous threaded fasteners. The metal covers such as Bradco and Sweepster employ are susceptible to cracks caused by vibration and corrosion. Large areas of paint on the underside of the metal broom covers

are soon scratched away due to the abrasive nature of the materials being swept. The molded plastic covers as seen in "Bobcat brochure number B-1619" are far better for resisting corrosion. One of the drawbacks related to these plastic covers is the way that they are fastened. The plastic covers expand in warm weather and contracts in cold. Bulges develop between the fasteners in hot weather providing a place for dirt to accumulate. In cold weather when the plastic contracts the accumulated dirt does not allow the plastic to return to its original shape causing cracks to occur around the fasteners;

(j) The parts required to assemble an average rotary angle broom is displayed in a typical prior art parts illustration as "BRADCO parts illustration CI-40" and "Bobcat parts illustration volume 3 attachments figure 61 item number 1". It is easy to realize that assembly of these rotary broom attachments can be intricate and time consuming resulting in added cost to the consumer. Given the large number of parts required to construct an adjustable rotary angle broom using prior art designs one can foresee the degree of maintenance that a broom of this design would need;

BACKGROUND OF INVENTION-OBJECTS AND ADVANTAGES

Accordingly, several objects and advantages of my invention are:

(a) To provide a sweeping attachment that will give the operator a higher degree of sweeping dexterity that will produce a savings over the prior art in time and equipment use, by: providing a better view in regards to the sweeping operation proper without detrimentally affecting his view of objects forward of the brush; allowing the operator to detect any skips or areas that must be readdressed as they occur thus the operator need not interrupt his sweeping task to appraise the

work he has accomplished; in essence provide the operator an increase in control over the brush to match the increase in view of the sweeping operation.

(b) To provide the operator a better view of objects in close proximity to the right and left sides of the machine without sacrificing the view of objects that are in the path of the brush. An inherent feature of skidsteer loaders is its ability to maneuver very quickly. The inability to clearly see objects or people near the machine can have dire consequences. In the operating position of my invention, the "quicktach adapter" that the brush assembly is mounted to is rotated forward in a horizontal position rather than a vertical position. This horizontal position gives the operator the narrowest possible profile or view of the "quicktach adapter" and will not detrimentally impair the operator's forward vision. In the operating position the boom arms of the skidsteer are elevated allowing the operator to see the tires of the skidsteer and any objects close to them;

(c) My invention is capable of sweeping at angles (yaw) greater than thirty degrees. This increase in operating angle (yaw) over that of prior art will require less power to operate as well as extend the life expectancy of the brush. By angling (yaw) the brush more it is apparent that less power will be needed. Less re-swept material will be encountered with each pass of the broom. Consequently the bristles will have less wear which will increase the life expectancy of the brush and the broom in general.

(d) To provide a rotary angle broom attachment for skidsteer loaders capable of sweeping vertical surfaces at an angle as well as overhead surfaces straight on. Most skidsteer tool attachments such as the bucket tool utilize the full pitch motion of the rotating joint that is located at the ends of the boom arms. Rotary angle brooms illustrated in prior art only use very little of this pivot motion. The Quicktach adapter" attached at this joint when mated to a conventional rotary

broom approximates vertical whether the broom is used or parked. My invention utilizes the full range of pitch motion available to the "quicktach adapter" therein giving my invention the ability to sweep horizontal surfaces, vertical surfaces, and ceilings.

(e) To provide an alternative method, that differs from prior art, to hydraulically angle the brush from the operator's seat. Prior art methods of alleviating this problem are either more expensive, more complicated, harder to maintain, prone to failure, or time consuming to connect and disconnect. My invention is less complicated, less costly, easier to maintain, and more dependable than what prior art offers. My invention utilizes a manual type selector valve that is mounted on the broom attachment at a location that the operator can easily reach. This is possible because of the ability of my device to utilize the full range of pivoting motion that is available to the "Quicktach adapter" previously discussed in (d) of Background of the Invention-Objects and Advantages.

(f) To provide a means by which to allow a skidsteer powered rotary angle broom, to sweep next to vertical structures with out leaving a skip. To insure this function my invention provides:

(1) A sturdy platform to which is mounted a gutter broom device. This platform is capable of enduring the rigors indigenous to gutter brooms usage.
(2) A simple means by which the gutter broom is retracted to a position that would not impair the operation of the rotary broom;
(3) A drive system for the gutter broom without the need to add additional hydraulics and insuring that both the gutter broom and the rotary brush are operating conjunctively;
(4) A simple means to easily install and remove the gutter broom as needed;

(5) A method to synchronize the speed of the gutter broom with the speed of the rotary brush;

(6) A means to conjunctively angle (yaw) the rotary brush and the gutterbroom;

(7) An overall design that gives the operator the means to control the pitch angle of the gutter broom providing that the functionality of both brooms remain interdependently constant as the pitch angle is adjusted;

(8) A mechanism that gives the operator an unobstructed view of the gutter broom working in conjunction with the rotary brush, at the same time provide the operator with unimpaired view of objects that the gutter broom is sweeping against;

(9) A means to automatically elevate the gutterbroom off the ground when it is not used, in order to protect the brush;

(g) To provide for a means by which to elevate the rotary brush off the ground automatically when the broom is parked and not in use, effectively insuring that the brush is protected.

(h) To provide an improved designed rotary angle broom skidsteer attachment that allows the broom to be inspected and maintained more easily than what is presented in prior art;

(i) To provide a cover assembly that is, easier to install or remove, less prone to cracking, cheaper to construct and less costly to maintain;

(j) To provide an invention that negates the need for jacks or legs that must be lowered each time the broom is disconnected and then raised each time the

broom is attached to the skidsteer, thereby increasing overall productivity of the operator and the machine;

(k) To provide a rotary angle broom attachment for skidsteer loaders that requires fewer pieces, less time to construct and costs less to produce.

Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

SUMMARY

A rotary brush assembly powered by a traction vehicle having a auxiliary hydraulic system, a forward and reverse direction of travel. The operator controlled brush assembly is capable of sweeping horizontal, vertical and overhead surfaces, in close proximity of protruding objects.

DRAWING—FIGURES

Fig. 1a. Is an overhead view depicting the straight forward position of a conventional rotary angle broom of a prior art design, in relationship to the tires of the skidsteer to which it is attached.

Fig. 1b. Is an overhead view depicting a sweeping pattern made by a conventional rotary angle broom of a prior art design operating at an angle of thirty degrees, in relationship to the tires of the skidsteer powering it.

Fig. 1c. Is an over head view depicting a sweeping pattern made by a conventional rotary angle broom of a prior art design operating at an angle of thirty five degrees, in relationship to the tires of the skidsteer powering it.

Fig. 2a. Is an overhead view depicting a sweeping pattern expressing the amount of sweepings a brush must re-sweep at the current angle of adjustment.

Fig. 2b. Is an overhead view depicting a sweeping pattern expressing the amount of sweepings a brush must re-sweep at an angle of adjustment that is greater than that exhibited in fig. 2a.

Fig. 3a. Is a side view of my invention in the parked position, of the preferred embodiment.

Fig. 3b. Is a side view of my invention in the operating position, of the preferred embodiment.

Fig. 4a. Is a perspective view displaying the two main frameworks my invention.

Fig. 4b. Is a perspective view of the two main frames of my invention assembled.

Fig. 5. Is a frontal view of my invention in the straight-forward position without the brush cover.

Fig. 6a. Is a over head view of my invention angled entirely to the right, depicting the swept area in relationship to the wheels of the skidsteer.

Fig. 6b. Is a over head view of my invention in the straight ahead position, depicting the swept area in relationship to the wheels of the skidsteer.

Fig. 6c. Is a over head view of my invention angled entirely to the left, depicting the swept area in relationship to the wheels of the skidsteer.

Fig. 7. Is a side view of my invention indicating the placement of its parts.

Fig. 8. Is a side view of the brush support frame and the cover support frame.

Fig. 8a. Is an exploded side view of cover slots support frame and the cover support frame.

Fig. 9. Is a frontal view of my invention in the straight forward position without the brush cover detailing the brush drive assembly.

Fig. 10. Is a side view of my invention showing the gutter broom attached to the brush support frame in its operating position.

Fig. 10a. Is a frontal view of my invention showing the gutter broom attached to the brush support frame in its operating position.

Fig. 11. Is an enlarged side view of my invention showing the gutter broom attached to the brush support frame in its operating position.

Fig. 11a. Is an enlarged frontal view of my invention showing the gutter broom attached to the brush support frame in its operating position.

Fig. 11b. Is an exploded frontal view of my invention showing the gutter broom drive mechanism.

Fig. 11c. Is a frontal view of my invention depicting the operating, intermediate and stored positions of the gutter broom.

Fig. 11d. Is an exploded frontal view of my invention showing the drive hub and cup that comprises the flexible drive coupler.

Fig. 12. Is of a alternative embodiment of my invention powered by a tracked backhoe working overhead.

Fig. 13. Is of a alternative embodiment of my invention powered by a tracked back hoe working in a trench exposing buried cable.

DRAWINGS—Reference Numerals

1. Skid steer loader
1a. Boom arms
1b. Hydraulic cylinders
1c. Operators cab
1e. Hydraulic cylinders
2. Broom assembly
3. Top quick attach adapter pivot joint
4. Pivot joint
5. Pitch axis
10. Support structure
10a. Quick attach receiver
10b. Beam
10d. Quick attach adapter
15. Hydraulic Cylinder
20. Brush support frame
20a. Brush

20b. Hydraulic motor
20c. Main beam
20d. Motor support member
20e. Bearing support member
20g. Broom shaft
20h. Bearing
20i. Threaded fasteners
20j. Bearing pad
20f. Splined coupler
21. Brush axis of rotation
27. Manual double selector valve
28a. Motor mount
30. Yaw pivot joint
31. Inner bushing
31a. Threaded fasteners
31b. Flat washers
31c. Threaded locking nuts
31g. Rear cross member
32. Outer bushing
33. Vertical axis
35. Pentagonal shaped gussets
35a. Skid shoes
35b. Threaded fasteners
37a. Forward brush cover members
37c. Front cross member
37d. Rear brush cover members
37g. Rear cross member
37m. Ninety-degree angle iron
38. Brush cover

38f. Front brush cover edge
38r. Rear brush cover edge
39f. Front brush cover retaining slot
39r. Rear brush cover retaining slot
50. Gutter broom Assembly
50b. Gutter broom brush
50c. Top hole
50d. Middle hole
50e. Bottom hole
50f. Roll joint
50i. Roll joint axis
50j. Backing plate
50k. Hub
50l. Driveline
50m. Drive hub
50n. Cup
50o. Drive shaft
50p. Pin
50q. Gearbox
50r. Input shaft
50s. Support plate
50t. Drive hub hole
50u. Gutter broom drive shaft hole
50v. Output shaft
50w. Shear pin
50x. Universal joint
51c. Top bushing
51d. Middle bushing
51e. Bottom bushing

DETAILED DESCRIPTION- FIGS. 3a, 3b, 3c, 3d, and 3e-PREFERRED EMBODIMENT

Fig. 3a shows the invention of a broom assembly 2 attached to a skid steer loader 1 in the parked position. Fig. 3b shows the invention in the work position of its preferred embodiment. A skid steer loader 1 is adapted for use in many industrial, agricultural and landscaping applications wherein easy maneuverability, power lifting and transporting capabilities are required. The skid steer loader 1 is provided with a pair of laterally spaced boom arms 1a that are driven along an arcuate path by hydraulic cylinders 1b. One end of the boom arms 1a are pivotally attached to the main body of the skid steer loader 1 on each side of the operator cab 1c. The opposite ends of the boom 1a arms are pivotally attached to the bottom of the "quick attach adapter" 10d forming pivot joint 4 rotating about a pitch axis 5. The tube ends of hydraulic cylinders 1e are pivotally attached on the boom arms and the rod ends of hydraulic cylinders 1e are also pivotally attached to the top of "quick attach adapter"1d forming pivot joint 3. The expansion and contraction of hydraulic cylinders 1e produces the pitch motion of pivot joint 4. The actuation of hydraulic cylinder 1e is a normal function of the skid steer loader 1 and is controlled by the operator.

Figs 4a and 4b shows broom assembly 2 divided into two main parts: The brush support frame 20 that holds a brush 20a and support structure 10 including a quick attach receiver 10a. The quick attach receiver 10a, is configured to be quickly attached and detached from the "quick attach adapter" mechanism 10d of the skid steer loader 1. The attachment is made and disconnected in a conventional manner.

Fig. 5 shows a frontal view of broom assembly 2. Brush 20a, in its preferred embodiment, is a transverse brush that is 72 inches wide with a diameter of 32 inches. The brush 20a rotates about axis 21, to sweep various surfaces clean of debris. In its preferred embodiment, brush 20a, is powered by a hydraulic motor 20b, which is hydraulically connected to a manual double selector valve 27. The manual double selector valve 27 is mounted on the topside of beam 10b, of support structure 10 and is connected to the skidsteer vehicle's existing

hydraulic system by hoses (not shown). This poses the first hydraulic circuit. The flow of oil to the manual double selector valve 27 is a normal function of the skidsteer that the operator controls.

In referring to Fig.s 4a, 4b, and 5, of the preferred embodiment, members and beams are constructed of a suitable tubular material. With this being said, the support structure 10 and the brush support frame 20, are connected together by an inner bushing 31 and an outer bushing 32 forming a yaw pivot joint 30 rotating about a vertical axis 33. Vertical axis 33 is centered on the brush 20a . A hydraulic cylinder 15 is mounted between the support structure 10 and the brush support frame 20 such that expansion and contraction of the hydraulic cylinder 15 pivots the broom to the desired angle of yaw. Rotation about a yaw axis of rotation 33 is facilitated by the yaw pivot joint 30. The operator controls the yaw rotation as a normal function of the skidsteer. In the preferred embodiment the angle is adjustable to 35 degrees in either direction from center. FIG.s 3a, 3b, and 3c illustrate yaw motion. Hoses (not shown) connect hydraulic cylinder 15 and manual double selector valve 27, establishing the second hydraulic circuit. The manual double selector valve 27 has two positions of operation. Position one of valve 27 allows oil to flows through the first hydraulic circuit powering hydraulic motor 20b. When valve 27 is placed in the second position, oil is diverted from the first hydraulic circuit to the second hydraulic circuit supplying oil to cylinder 15.

Fig 7 shows a side view of the preferred embodiment. In constructing pivot joint 30 outer bushing 32 is cut to a width of three and fifteen sixteenth inches from standard seamless round tubing stock having an outside diameter of eighteen inches, and an inside diameter of seventeen and one fourth inches. The inner bushing 31 is formed from an appropriate length of steel flat bar-stock four inches wide and three-eighths of an inch thick. The bar-stock is rolled to conform to the inside diameter of outer bushing 32. The rolled bar-stock is inserted into the outer bushing 32 and allowed to expand, further conforming to the inside diameter of

outer bushing 32. A weld is placed on the seam of the rolled bar-stock creating inner bushing 31. This method of producing the pivot joint is efficient and requires no machining.
The quick attach receiver 10a is permanently located on the topside and at one end of beam 10b of support structure 10. Inner bushing 31 is located at the opposite end of beam 10b and centered on the bottom side, where it is welded in place. These welds must be made on the inside of inner bushing 31. Figure 7 shows the assembly of the preferred embodiment. Threaded fasteners 31a are permanently fixed, front and rear, to the inside of inner bushing 31. The inner bushing 31 of support structure 10 is fitted into outer bushing 32 of brush support frame 20. Threaded fasteners 31a protrude downward and extend one inch past bushings 31 and 32. Flat washers 31b and threaded locking nuts 31c are installed onto threaded fasteners 31a and tightened. At the ends of rear cross member 37g are welded pentagonal shaped gussets 35 to which skid shoes 35a are loosely attached by threaded fasteners 35b.

Fig. 4a and 4b shows outer bushing 32 welded to the topside and centered on main beam 20c of brush frame support 20. These welds must be made on the outside of outer bushing 32. One end of motor support member 20d is welded to the underside and at one end of the main beam 20c. Motor mount 28a is welded to the exposed end of motor support member 20d. On the bottom side and on the opposite end of main beam 20c is welded bearing support member 20e. Bearing pad 20f is welded to the exposed end of bearing support member 20e. Three bushings 51c, 51d, and 51e, are vertically spaced and weld installed in bearing support member 20e. These vertically spaced bushings are the points of attachment for the gutter broom assembly 50. Bushings 51c, 51d, and 51e have an inside diameter of ¾ inch, an outside diameter of 1 ½ inch and a length of 5 inches. Bushing 50d and pin 50p comprise a roll joint 50f about roll joint axis 50i.

The brush cover 38 is supported by a brush cover frame. Forward brush cover members 37a are welded to the front side of the motor support member 20d and 20e. The two forward

brush cover members 37a are conjunctively aligned and extend forward ninety degrees from the motor support member 20d and the bearing support member 20e. Front cross member 37c is rotated on a pitch axis of forty-five degrees and welded to the exposed ends of forward brush cover members 37a.

The two rear brush cover members 37d are welded to the backsides of members 20d/22e. They are conjunctively aligned, sloping diagonally downward, and away from members 20d/22e, at an angle approaching fifty eight degrees. Cross member 37g is a square tubing and is positioned so that two sides are parallel with the vertical sides of motor support member 20d and bearing support member 20e. Cross member 37g is welded to the exposed ends of brush cover members 37d.

Fig. 6c shows that front cross member 37c and the rear cross member 37g are parallel to the brush 20a and the main beam 20c. Figs. 8 and 8a show brush cover 38 held in place the two brush cover retaining slots 39f and 39r, and two self-tapping threaded fasteners (not shown). Retaining slot 39r is formed by welding a ninety-degree angle iron 37m, longitudinally along the front side of rear cross member 37g. Retaining slot 39f is formed by welding a ninety-degree angle iron 37m longitudinally along the underside of front cross member 37c. The width of brush cover 38 is equal in length to the arc of a circle segment measured from the bottom of retaining slot 39r to the bottom of retaining slot 39f and having as its center point, axis of brush rotation 21. The length of brush cover 38 is equal to ½ inch less than the distance between the two rear brush cover members 37d and 37e.

In its preferred embodiment brush cover 38 is made from a sheet of plastic and having a thickness of ¼ inch. The properly sized plastic sheet is installed from the underside of frame 20, centered between brush cover members 37d and 37e. Edge 38r of the plastic sheet is seated into retaining slot 39r. Pressure is applied to the center of the plastic sheet causing it to arch, forcing edge 38f to slip past retaining slot 39f. The pressure is then relieved. The elasticity of the plastic sheet will force the edges 38f and 38r deeply into retaining slots 39r

and 39f respectively. One self-tapping threaded fastener (not shown) is positioned on the longitudinal center of slot 39f and one self-tapping threaded fastener (not shown) is positioned on the longitudinal center of slot 39r. Pilot holes for the threaded fasteners pierce through the ninety-degree angle iron 37m, through the ¼ inch thickness of plastic sheet 39, and through the wall of cross members 37c and 37g. With this configuration bulges cannot occur in brush cover 38, because the expansion of the plastic is unrestricted, there by reducing the possibility of cracks forming in brush cover 38.

Fig 9 shows hydraulic motor 20b to be connected to broom shaft 20g by, splined coupler 20f. Broom shaft 20g has a diameter of one and one quarter inches. Coupler 20f is of the splined type common to the industry. One end of splined coupler 20f is to be installed on the splined output shaft of hydraulic motor 20b. The opposite end of coupler 20f is welded to one end of broom shaft 20g. On the opposite end of broom shaft 20g is located bearing 20h. Bearing 20h is mounted to Bearing pad 20j by threaded fasteners 20i.

FIG.s 10 and 10a shows a side view and a frontal view of the preferred embodiment of gutter broom assembly 50 attached to broom assembly 2. Figs 11 and 11a are sectional enlargements of figs. 10 and 10a. In the preferred embodiment gutter broom brush 50b is of the same diameter as brush 20 and is attached to backing plate 50j. Backing plate 50j is fastened to the outside diameter of hub 50k. Hub 50k slips onto output shaft 50v and is locked in place. Gearbox 50q has a ratio of 1:1 and is configured to rotate the gutter broom brush 50b in the proper direction in order to work cooperatively with brush 20a.

Matching support plates 50s are spaced five inches apart. One support plate is located on the front side of bearing support member 20e and one support plate located on the rear side of bearing support member 20e. Holes 50d and 50e in support plates 50s are ¾ inch in diameter and are aligned with the bores of vertically spaced bushings 51d, and 51e of bearing support member 20e. The alignment of gutter broom assembly 50 is maintained by the placement of pins 50p through holes50c/51d and 50c/51e of the support plates 50s and

through bushings 51d, and 51e of bearing support member 20e. Right angle gearbox 50q is positioned between support plates 50s on the end opposite holes 50d and 50e. Threaded fasteners secure the support plates 50s to gearbox 50q. The design of support plates 50s is such that the axis of rotation of the input shaft 50r of gearbox 50q is maintained in approximation to the axis of rotation 21 of broom shaft 20g. Holes 50c of support plates 50s are positioned 90 degrees in relation to holes 50d and 50e of support plates 50s. The distance between the centers of holes 50c and 50d is equal to the distance between the centers of holes 51c and 51d of bearing support member 20e. The design of support plates 50s are such that by removing pin 50p from pinhole 50e/51e the gutter broom assembly 50 can be rotated upward 90degrees. This rotation takes place at roll joint 50f. Pin 50p can then be reinstalled into holes 50c/50d to lock the gutter broom into the stored position as shown in fig 11c.
Fig. 11b is an enlarged drawing showing the gutter broom driveline 50l. Rotational force is supplied to gearbox 50q by motor 20b through broom shaft 20g and driveline 50l. Drive shaft 20g is fitted with drive hub 50m. Cup 50n slips over drive hub 50m and is welded to one end of drive shaft 50o. On the opposite end of drive 50o is attached a universal joint 50x that is fitted to the input shaft 50r of gearbox 50q.

Fig. 11d shows the drive connection between drive shaft 20g and drive shaft 50o of the preferred embodiment. Drive hub 50m and cup 50n work in conjunction to form a, self-aligning, detachable, drive coupling. Drive hub 50m is made from a two-inch square steel shaft having a length of one and one quarter inches. All eight edges are beveled each way from the center, to a depth of 1/8 inch, ending at the edges. Drive hub 50m fits snuggly inside cup 50n while allowing drive hub 50m to oscillate, maintaining an alignment of drive shaft 50o. A ¼ inch diameter hole 50t is placed in shaft 20g 1 inch from the end. Drive hub m has a corresponding hole 50u through which shear pin 50n is fitted. Shear pin 50n is designed to shear if the torsional load on gutter broom brush 50b becomes to great, there-by protecting gearbox 50q from damage.

Additional Embodiments Figs. 12 and 13

A preferred embodiment of the invention has been previously described. Those skilled in the art will recognize that many embodiments are possible within the scope of the invention. Variations and modifications of the various parts and assemblies can certainly be made and still fall within the scope of the invention. The invention is not limited for use with skidsteer loaders. Because of the way the invention is designed other powering sources can be employed such as backhoe excavators as shown in fig 12. A modification of the broom could make the attachment usable to uncover buried objects as in fig 13. Another embodiment would be to substitute a brush of the type employed in car washes with the bristle brush exhibited in the preferred embodiment.

OPERATION OF INVENTION figs 3a, 3b, 3c, 3d, 3e, 3f, 10 and 10a

Fig 3a shows the conventional method of mounting broom assembly 2 to skidsteer 1 by fitting quick attach adapter 1d of skidsteer 1 into quick attach receiver 10a of broom assembly 2. To complete the attachment process, hydraulic hoses (not shown) are connected to the auxiliary hydraulic system of skidsteer 1 leading to manual double selector valve 27 mounted on broom assembly 2. The operator then places manual double selector valve 27 in the position that supplies oil to the first hydraulic circuit. Fig 3a also shows broom assembly 2 in its parked position. Broom assembly 2 rests on the right and left skid shoes 35a and on the rear of the quick attach receiver 10a. In the parked position brush 20a is automatically elevated off the ground providing easy access for inspection and maintenance of brush 20a, bearing 20h, as well as motor 20b.

Fig 3b shows skidsteer 1 and broom assembly 2 in the work position. The operator can clearly see the back side of brush 20a and also any skips as they occur. Notice that boom arms 1a are elevated giving the operator an unobstructed view of objects to the immediate sides of the skidsteer.

To place broom assembly 2 in the straight ahead operating position shown in fig. 3b, the skidsteer operator raises boom arms 1a and extends hydraulic cylinders 1e causing quick attach adapter 1d to rotate pivot joint 3 about pitch axis 5. The operator continues extending hydraulic cylinders 1e until quick attach adapter 1d is approximately parallel with the ground, placing the broom assembly in the operating position. Fig 3b shows skidsteer 1 and broom assembly 2 in the work position. The operator can now control the down pressure applied to brush 20a by adjusting the elevation of boom arms 1a. Notice that boom arms 1a are elevated giving the operator an unobstructed view of objects to the immediate sides of the skidsteer.

To adjust the yaw angle of brush 20a, the operator fully retracts cylinders 1e causing quick attach adapter 1d to rotate pivot joint 3 about pitch axis 5. Quick attach adapter 1d will be rotated to a position past vertical as shown in Fig. 3c. The operator adjusts the elevation of boom arms 1a to a position where double selector valve 27 can easily be reached. The operator then places manual double selector valve 27 in the position that supplies oil to the second hydraulic circuit, containing cylinder 15. The operator activates the control that directs oil to cylinder 15 changing the angle of brush 20a to a desired position. The operator then repositions manual double selector valve 27 to redirect the oil flow back to circuit one containing hydraulic motor 20b. The operator is now free to reposition the broom assembly 2 in the operating position discussed previously.

Fig 3d shows the capability of broom assembly 2 to sweep debris from walls and ceilings. To accomplish this the operator places quick attach adapter 1d in a vertical position. He then moves the skidsteer forward until rotating brush 20a comes in contact with the wall. Using the normal operator controlled forward or reverse motion of the skidsteer varies the pressure that the brush exerts against the wall. By adjusting the elevation of boom arms 1a the operator can raise or lower rotating brush 20a progressively sweeping the wall. To sweep ceilings the operator places the quick attach adapter 1d in a vertical position. Boom arms 1a are elevated until brush 20a contacts the ceiling. Adjusting Boom arms 1a will dictate the amount of pressure brush 20a exerts against the ceiling. The operator by way of the

skidsteers controlled travel capabilities such as forward, reverse, and turning, can direct rotating brush 20a in a progressive sweeping pattern across the ceiling. To eliminate skips associated with sweeping next to protruding structures, gutter broom assembly 50 is attached to broom assembly 2 and placed in its work position as illustrated in Figs. 10 and 10a. The operator adjusts the yaw angle of brush 20a so that gutter broom brush 50b is ahead of brush 20a as shown in fig. 3f. Ideally the leading edge of gutter broom brush 50b should contact the surface to be swept while the trailing edge does not as shown in fig.3e. The sweeping surface of gutter broom brush 50b is parallel with quick attach adapter 1d. The operator can control the effectiveness of the gutter broom by adjusting the pitch of quick attach adapter 1d thereby adjusting the pitch angle of gutter broom brush 50b. The operator can maintain operational continuity between gutter broom brush 50b and brush 20a by adjusting the elevation of boom arms 1a. Downward force will expand the diameter of gutter broom brush 50b as well as increasing the pressure with which brush 20a contacts the surface to be swept. Gutter broom brush 50b can be made to act independently of brush 20a by rotating quick attach adapter 1d fully forward increasing the pitch angle of gutter broom brush 50b. In this position brush 20a is held off the swept surface and all the downward pressure that the skidsteer operator can bring to bear is applied to the leading edge of gutter broom brush 50b. Operating the gutter broom in this mode enables gutter broom brush 50b to effectively sweep depressions adjacent to vertical structures.

Objects and Advantages

Accordingly, several objects and advantages of my invention are:

(l) To provide a sweeping attachment that will give the operator a higher degree of sweeping dexterity that will produce a savings over the prior art in time and equipment use, by: providing a better view in regards to the sweeping operation proper without detrimentally affecting his view of objects forward of the brush; allowing the operator to detect any skips or areas that must be

readdressed as they occur thus the operator need not interrupt his sweeping task to appraise the work he has accomplished; in essence provide the operator an increase in control over the brush to match the increase in view of the sweeping operation.

(m) To provide the operator a better view of objects in close proximity to the right and left sides of the machine without sacrificing the view of objects that are in the path of the brush. An inherent feature of skidsteer loaders is its ability to maneuver very quickly. The inability to clearly see objects or people near the machine can have dire consequences. In the operating position of my invention, the "quicktach adapter" that the brush assembly is mounted to is rotated forward in a horizontal position rather than a vertical position. This horizontal position gives the operator the narrowest possible profile or view of the "quicktach adapter" and will not detrimentally impair the operator's forward vision. In the operating position the boom arms of the skidsteer are elevated allowing the operator to see the tires of the skidsteer and any objects close to them;

(n) My invention is capable of sweeping at angles (yaw) greater than thirty degrees. This increase in operating angle (yaw) over that of prior art will require less power to operate as well as extend the life expectancy of the brush. By angling (yaw) the brush more it is apparent that less power will be needed. Less re-swept material will be encountered with each pass of the broom. Consequently the bristles will have less wear which will increase the life expectancy of the brush and the broom in general.

(o) To provide a rotary angle broom attachment for skidsteer loaders capable of sweeping vertical surfaces at an angle as well as overhead surfaces straight on. Most skidsteer tool attachments such as the bucket tool utilize the full pitch motion of the rotating joint that is located at the ends of the boom arms. Rotary angle brooms illustrated in prior art only use very little of this pivot motion. The

Quicktach adapter" attached at this joint when mated to a conventional rotary broom approximates vertical whether the broom is used or parked. My invention utilizes the full range of pitch motion available to the "quicktach adapter" therein giving my invention the ability to sweep horizontal surfaces, vertical surfaces, and ceilings.

(p) To provide an alternative method, that differs from prior art, to hydraulically angle the brush from the operator's seat. Prior art methods of alleviating this problem are either more expensive, more complicated, harder to maintain, prone to failure, or time consuming to connect and disconnect. My invention is less complicated, less costly, easier to maintain, and more dependable than what prior art offers. My invention utilizes a manual type selector valve that is mounted on the broom attachment at a location that the operator can easily reach. This is possible because of the ability of my device to utilize the full range of pivoting motion that is available to the "Quicktach adapter" previously discussed in (d) of Background of the Invention-Objects and Advantages

(q) To provide a means by which to allow a skidsteer powered rotary angle broom, to sweep next to vertical structures with out leaving a skip. To insure this function my invention provides:

(1) A sturdy platform to which is mounted a gutter broom device. This platform is capable of enduring the riggors indigenous to gutter brooms.
(2) A simple means by which the gutter broom is retracted to a position that would not impair the operation of the rotary broom;
(3) A drive system for the gutter broom without the need to add additional hydraulics and insuring that both the gutter broom and the rotary brush are operating conjunctively;
(4) A simple means to easily install and remove the gutter broom as needed;

(5) A method to synchronize the speed of the gutter broom with the speed of the rotary brush;

(6) A means to conjunctively angle (yaw) the rotary brush and the gutterbroom;

(7) An overall design that gives the operator the means to control the pitch angle of the gutter broom providing that the functionality of both brooms remain interdependently constant as the pitch angle is adjusted;

(8) A mechanism that gives the operator an unobstructed view of the gutter broom working in conjunction with the rotary brush, at the same time provide the operator with unimpaired view of objects that the gutter broom is sweeping against;

(9) A means to automatically elevate the gutterbroom off the ground when it is not used, in order to protect the brush;

(r) To provide for a means by which to elevate the rotary brush off the ground automatically when the broom is parked and not in use, effectively insuring that the brush is protected.

(s) To provide an improved designed rotary angle broom skidsteer attachment that allows the broom to be inspected and maintained more easily than what is presented in prior art;

(t) To provide a cover assembly that is, easier to install or remove, less prone to cracking, cheaper to construct and less costly to maintain;

(u) To provide an invention that negates the need for jacks or legs that must be lowered each time the broom is disconnected and then raised each time the broom is attached to the skidsteer, thereby increasing overall productivity of the operator and the machine;

(v) To provide a rotary angle broom attachment for skidsteer loaders that requires fewer pieces, less time to construct and costs less to produce.

Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

Conclusion, Ramifications, and Scope

Accordingly, the reader will see that the rotary angle broom attachment of this invention can be used to sweep horizontal, vertical, and overhead surfaces. This invention provides the operator with the visibility of the sweeping process to equal the agility of the traction vehicle that powers it, providing a safer, more efficient sweeping attachment. In addition the rotary angle broom attachment of this invention has the additional advantages in that

- it permits the operator more control of the sweeping operation in the operator regulates the amount of down pressure that is applied.
- it provides a rotary sweeper that can angle more than thirty degrees thereby reducing brush wear, without exposing the wheel tracks of the skidsteer.
- it provides for a means by which to sweep directly next to protruding objects stemming from the surface to be swept greatly reducing skips.

  it permits the operator to angle the brush from the operators seat without the need for additional electrical wiring and controls.

  it eliminates the need for extendable legs or jacks to keep the brush elevated off the ground.

- it provides a brush cover system that is less costly to build, easier to install, more durable and easier to maintain.

Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention.

Claims:

Having described my invention in such terms as to enable those skilled in the art to understand and practice it, and having identified the presently preferred embodiments thereof, I claim:

1. A rotary brush assembly powered by a traction vehicle having an auxiliary hydraulic system, a forward and reverse direction of travel empowering said assembly to sweep horizontal, vertical and overhead surfaces, in close proximity of protruding objects, comprising:

a) a mounting frame;

b) a brush support frame;

c) a rotary brush operatively connected to the brush support frame;

d) a yaw pivoting joint permitting rotation of the frame about a first axis substantially perpendicular to the ground;

e) a gutter broom assembly operatively connected to the brush support frame;

f) a brush cover;

2. The brush assembly of claim 1 wherein the rotary brush rotates about an axis of rotation substantially parallel to the ground when the brush support frame is in its centered position.